

### **Remarks**

Claims 24 - 40 are pending. Former claims 1 - 12 and 18 - 23 have been cancelled. Favorable reconsideration is respectfully requested.

The subject invention is directed to pumpable, sprayable, strain hardening mortar. In the past, the application of such mortars was limited in thickness when applied to vertical or highly inclined surfaces as well as to the bottom of a horizontal surface, for example as a tunnel lining. The compositions, if applied too thickly, would run, sag, or drip. The present inventor discovered that introduction of a non-Newtonian additive, preferably calcium aluminate cement, along with reinforcing fibers of defined characteristics, produces a sprayable mortar which can be applied much more thickly than prior mortars, and which, when cured, exhibit strain hardening behavior. Strain hardening is an unusual phenomenon in hydraulically settable mortars, introduced by the addition of specific reinforcing fibers. The reinforcing fibers must interact with the matrix, yet only to a limited degree, otherwise strain hardening will not occur. Thus, for example, stainless steel fibers, polypropylene fibers, and low and medium density polyethylene fibers are unsuitable for use in strain hardening compositions.

The claims have been amended somewhat in their rewritten form to more particularly point out and distinctly claim what Applicants regard as their invention. It should be noted, as the Examiner is well aware, that the claims are addressed to one of ordinary skill in the art. The claims are fully supported by the application as filed, including the original claims. For claim 24, the broadest claim, for example the claim is very similar to that originally filed, with the following additional limitations: for a), the volume % of strain hardening fibers is found in the specification on page 9, lines 18 - 25; their length on page 10, lines 15 - 22; their diameter on page 10, lines 21 - 22; their interface frictional stress on page 10, line 11, and their interfacial chemical bonding at page 10, lines 2 - 4. For b), support may be found on page 7, lines 4 - 5 and page 8, lines 4 - 5. It should be noted that one skilled in the art recognizes that cements such as Portland cement produce a mortar which has limited

non-Newtonian character. However, this character is not due to an additive, but to the inherent properties of the cement. One skilled in the art would not term Portland cement as a non-Newtonian additive.

Component c) is present in the original claim 1; component d) is present in original claim 1, the amount of superplasticizer being found in the specification on page 9, lines 13 - 17. For component e), see original claim 1. The structure of claim 24 makes clear that components a) through e) are additional components from the cement itself, and there is no overlap between these categories. For example, when Portland cement is the hydraulically settable cement component, it is not also a non-Newtonian additive. The claim is fully supported by the specification as filed as viewed by one skilled in the art. The remaining claims also find full support in the specification. For example, fiber volume percents of claims 31 and 32 may be found on page 9, lines 18 - 25; the percentage strain prior to failure (claims 33 - 35) may be found in claims 9 - 10 as filed; and the amounts and types of aggregate (claims 40 - 42) on page 11. No new matter is introduced.

Prior claim 7 had been rejected under 35 U.S.C. § 112/§ 132 for the use of the term "other than calcium aluminate cement." The Office termed this phase new matter. The Office is respectfully directed to page 7, lines 4 - 7, where it is indicated that for the purposes of the present invention, calcium aluminum cement is not included in the definition of hydraulically setting cements. Thus, the specification states that hydraulically setting cements are other than calcium aluminate cement, and thus there is no issue of new matter.

The prior claims had also been rejected under 35 U.S.C. § 112 ¶2 as indefinite "because the cement fraction is non-Newtonian". Applicants have defined the non-Newtonian additive of claim 24 as being one or more of calcium aluminate cement and organic non-Newtonian additives. The claim language is clearly definite. As indicated previously, one skilled in the art would not view Portland cement as an "additive". Nor would one skilled in the art confuse aggregate such as fly ash with a viscosity control agent. The latter are understood to be additives which cause a great change in viscosity at low concentration, such

as the various cellulose derivatives. While fly ash, at high concentrations, will increase viscosity, one skilled in the art, to whom the claims are addressed, view fly ash as an aggregate, not as a viscosity control agent.

It is submitted that the present claims distinguish patentably over the references of record. The Office is requested to peruse the following comments.

Beauml et al. '607 ("*Beauml*") does not disclose the use of any non-Newtonian additive as defined by the claims. *Beauml* is directed to providing cement mixtures which prevent corrosion in steel reinforcement. The secondary references *Aadnoy* and *Papadakis* indicate that Portland cement mixtures are themselves partially non-Newtonian. However, as shown by the comparative Examples (both of which are Portland cement-based), the subject invention achieved greater than a four-fold increase in applyable thickness on vertical surfaces, while the comparative formulations failed to adhere to overhead surfaces. Clearly, the limited non-Newtonian behavior due to Portland cement alone is very insufficient, which is why a non-Newtonian additive must be employed.

*Kodama* does not disclose any non-Newtonian additive within the scope of the invention. The "keyword" section lists "polyamide fibers, uses", but does not indicate that fibers are added to the cement. There is also no indication as to whether the polyamide fibers are in the form of individual fibers, bundles of fibers, continuous strands or tow, or fabric. The reference may, for example, be to paper casting forms wrapped with polyamide fabric for reinforcement, or use of polyamide textiles in layers in applied concrete (which would therefore not be sprayable). There is also no disclosure of any particular type of polyamide, and no indication of modulus, strength, or interfacial chemical bonding. The secondary references add nothing to *Kodama*.

*Kanda* discloses sprayable concrete containing reinforcing fibers, but does not indicate whether the fibers only reinforce, or whether they produce strain hardening behavior, as required by the claims. There is no disclosure as to whether the polyvinyl alcohol fibers

meet the interfacial chemical bonding range. Note that the polyvinyl alcohol fibers used by Applicants are oiled to reduce their interaction with the matrix to be within the claimed range. *Kanda* discloses no non-Newtonian additive. The secondary references add nothing to *Kanda*.

The *O'Connell* references pertain to acoustical coatings which are clearly far different from those of the subject invention. For example, they do not meet the requirements of 0.1 to 4.0 volume percent fibers. *O'Connell* uses vastly more fibers and does not produce a structural component. The "cement" of *O'Connell* is a very small part of the composition, used only to bind the fibers together in a sound-absorbant coating whereas in Applicants' composition is a major part, and forms the matrix surrounding the fibers.

*O'Connell* discloses no fibers which meet the strength, modulus, and interfacial chemical bonding requirements necessary for strain hardening behavior. While *O'Connell* mentions polyethylene fibers, he does not indicate whether these are high density fibers. Rather, they would appear to be LLDPE or LDPE fibers, since there is no requirement for strength in these very light coatings, nor is there any indication of strain hardening behavior.

Finally, *O'Connell* discloses no non-Newtonian additive within the scope of the claims. The secondary references add nothing to *O'Connell*.

*Blounts* does not disclose any non-Newtonian additive, and does not disclose any fibers which meet the claim limitations of strength, modulus, and interfacial chemical bonding of the subject invention. A teaching of polyethylene is not a teaching of high density polyethylene. LLDPE and LPE, for example, the more common forms of polyethylene, will not work to produce strain hardening, nor will polypropylene. The secondary references add nothing to *Blounts*.

*Zimmerman* discloses low density thermal insulator compositions, but fails to teach the use of any non-Newtonian thickener, nor does *Zimmerman* disclose any reinforcing fibers meeting the claim limitations. Note that the fibers disclosed are also too short to

produce strain hardening behavior and further do not meet the remaining claim limitations. The secondary references add nothing to *Zimmerman*.

*Ding* does not disclose any fiber meeting the claim limitations with respect to modulus, interfacial chemical bonding, etc. The organic fibers employed by *Ding* are not for structural purposes, but for sound attenuation. There is no indication that the *Ding* composition is strain hardening. The secondary references add nothing to *Ding*.


*Hatschek* discloses cements containing polyethylene fibers, but no indication of what type of polyethylene fibers these are. *Hatschek* discloses no non-Newtonian additive. The secondary references add nothing to *Hatschek*.

The claims have been rewritten to include the fiber characteristics in terms of their length, modulus, frictional stress, and interfacial chemical bonding. None of the references teach such fibers, which is not surprising, since as far as Applicants can determine, none of the references are directed to producing strain hardening compositions, but rather employ fibers for strength (not strain hardening), sound attenuation, etc. Many of the references, in particular the abstracts, are quite ambiguous. It is noted that a reference which is ambiguous cannot be used in rejecting claims under any section of the statutes. Applicants have also examined the references which have been cited as of interest and fail to find any reference or combination thereof which would render the present claims unpatentable. Withdrawal of all rejections of record is respectfully solicited.

Applicants submit that the claims are now in condition for Allowance, and respectfully request a Notice to that effect. If the Examiner believes that further discussion will advance the prosecution of the Application, the Examiner is highly encouraged to telephone Applicants' attorney at the number given below.

A check in the amount of \$ 60.00 is enclosed to cover the Petition fee. Please charge any additional fees or credit any overpayments as a result of the filing of this paper to our Deposit Account No. 02-3978.

Respectfully submitted,  
**VICTOR C. LI et al.**

By   
William G. Conger  
Reg. No. 31,209  
Attorney/Agent for Applicant

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**BROOKS KUSHMAN P.C.**  
1000 Town Center, 22nd Floor  
Southfield, MI 48075-1238  
Phone: 248-358-4400  
Fax: 248-358-3351